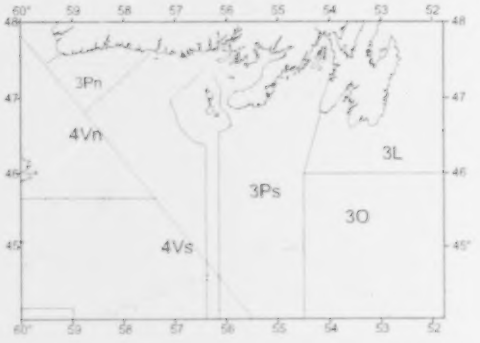
Subdivision 3Ps Cod



Background

Cod are found on both sides of the Atlantic. In the Northwest Atlantic, they are distributed from Greenland to Cape Hatteras and are managed as 12 stocks. The 'St. Pierre Bank' stock extends from Cape St. Mary's to just west of Burgeo Bank, and over St. Pierre Bank and most of Green Bank.

The distribution of fish does not conform well to management boundaries and the stock is considered to be a complex mixture of subcomponents. These may include fish that move seasonally into the area from adjacent stocks as well as fish that undergo migrations within the area. Fish are caught offshore by mobile gear and inshore by fixed gear. The extent to which the different components contribute to the fisheries is not fully understood.

Cod from this stock generally grow faster than those in more northerly areas. At least 50% of the females have been found to be mature by age 5 (53cm) in recent years, compared to age 6 (58cm) in the 1980s.

Catches from this stock have supported an inshore fixed gear fishery for centuries and have been of vital importance to the area. The stock was heavily exploited by Spain and other foreign fleets in the 1960s and early 1970s. French catches increased in the offshore throughout the 1980s. A moratorium on fishing initiated in August, 1993 ended in 1997 and the fishery reopened on May 19th with a quota set at 10,000 t.

The Fishery

The stock was heavily exploited in the 1960s and early 1970s by foreign fleets, mainly from Spain, with catches peaking at 84,000 metric tons in 1961. After the extension of jurisdiction in 1977, cod catches averaged around 30,000 metric tons until the mid-1980s when fishing effort by France increased and total landings reached about 59,000 metric tons in 1987. Catches then declined gradually to 36,000 metric tons in 1992. A moratorium was imposed in August 1993 after only 15,000 metric tons had been landed. Although offshore landings have fluctuated, the inshore fixed gear fishery reported landings around 20,000 metric tons each year up until the moratorium. The fishery reopened during May 1997 with a TAC of 10,000 t.

In 1997 the reopened 3Ps commercial fishery, including a French allocation of 1,560 t, together with catches from the sentinel survey, a recreational fishery and bycatch resulted in reported landings of about 9,000 t. About 1,300 t was caught by

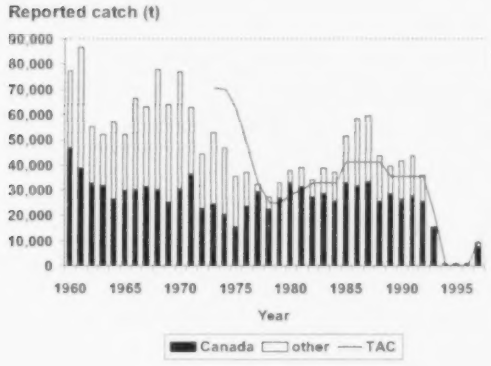
Canada

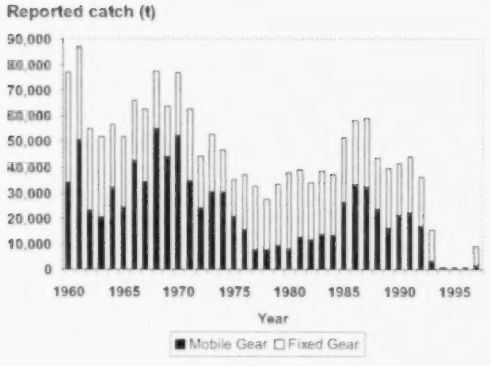
otter trawlers and the remainder by inshore fixed gear.

Landings (thousand metric tons)

Year	59-76 Avg.	77-92 Avg.	1993	1994[1]	1995[1]	1996[1]	1997[1]
TAC	-	-	20	0	0	0	10
Can.	30	29	15	1	1	1	7
Others	29	12	+	0	0	0	2
Totals	59	41	15	1	1	1	9

[1] Provisional
+ Catch less than 500 metric tons





Resource Status

Stock status was estimated from **commercial landings** in conjunction with **abundance and biomass indices** from Canadian (1978-1997) and French (1980-1991) research vessel trawl surveys. Additional sources of information for 1997 included an **industry trawl survey** on St. Pierre Bank, **sentinel surveys** (1995-1997), **acoustic surveys** in Placentia Bay and Fortune Bay, and tagging experiments in Placentia Bay. A **new logbook** was introduced in 1997 for vessels less than 35 ft. to provide detailed information on catch and effort for the inshore fixed gear fishery.

A reliable interpretation of stock status is impeded by severe problems of stock structure, seasonal migrations, variability in trawl survey estimates and poor quality historical data on catch and effort. Analysis of the information required assumptions to be made which, in the light of these complications, are known to be oversimplied. Nevertheless, a variety of analyses were carried out in an attempt to extract as much information as possible on stock status from the available data.

The 1997 spring **bottom trawl survey** was carried out on this stock for the second time with the Campelen 1800 shrimp trawl. Additional inshore strata were added to the survey area in trawlable areas of Fortune Bay and Placentia Bay. Before the results could be compared with past surveys, the time series had to be converted to equivalent units based on the results of extensive comparative fishing experiments carried out with the old and new gear. The new trawl is much more effective at catching small cod than the old gear but equally effective at catching large cod.

The converted **biomass index** from 1983 to 1997 shows considerable variability, but is low after 1991. The 1995 estimate is influenced by a single enormous catch contributing 87% of the biomass index. The 1997 Canadian trawl survey index was the lowest observed in the time series which

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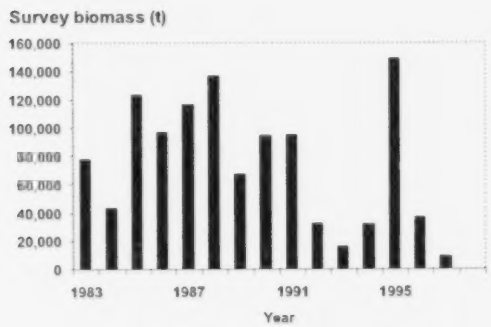
goes back to 1983, being less than half of the 1996 index. Few fish older than age 9 were encountered. There was no indication of incoming year classes of any significance. Fish were, however, somewhat more widespread over the survey area than in previous recent years, albeit at low abundance. The minimum trawlable biomass, including new inshore strata added in 1994, and extended further shoreward in 1997, was 9,500 t (95% confidence interval = 4,500 t - 15,000 t), less than one third of the 1996 survey. The size composition of fish in the 1997 research vessel survey were very different from 1996 and suggested that the most recent survey missed aggregations of older fish. These fish were, however, present in the 1996 research vessel survey, the fall 1997 industry trawl survey and the commercial and sentinel catches in 1997.



Estimates of **total mortality** (Z) in the offshore from research vessel surveys are variable but do not suggest the increases in non-fishing mortality seen in surrounding cod stocks (2J3KL, 3Pn4RS, 4TVn, 4VsW).

Historical data (prior to 1994) from log-books for vessels >35ft and purchase slips are not considered to be reliable indicators of catch or effort over time. Data from the new logbooks introduced in 1997 for vessels less than 35 ft. were evaluated with regard to their quality and their potential future usefullness in the assessment of the stock. The proportion returned was relatively high and the information content comparatively good. The data indicated high catch rates for all gear types that participated in the fishery. There was no indication of a decline in catch rate as the season progressed.

Two **industry bottom-trawl surveys** were carried out on St. Pierre Bank in the fall of 1997. The first used a grid survey design. This survey constitutes the beginning of a new time series and the results were not used to determine stock status in the current assessment. The second industry survey used the same basic stratified random design adopted in the research vessel surveys. This survey encountered fish in the southern Halibut Channel area, on the top of St. Pierre Bank and along the western edge of the Bank. The preliminary estimate of trawlable biomass is 105,000 t but this will be updated when estimates of the swept area and the survey area are completed. Fish aged 5, 7 and 8 dominated the catches and there were few fish older than age 9.

A fixed gear **sentinel survey** has been conducted at several sites along the south coast of Newfoundland from St. Brides to Burgeo. The survey began in late February of 1995 and continued in 1997. Gillnet catch rates have been similar for the three years of the survey. Linetrawl catch rates were also similar throughout the survey period. Cod trap catches were higher in 1997 than in 1995-96. Sentinel fishers indicated that catch rates for all gears were good. Commercial and sentinel fishing practices were so dissimilar that the catch rates could not be combined into a single series.

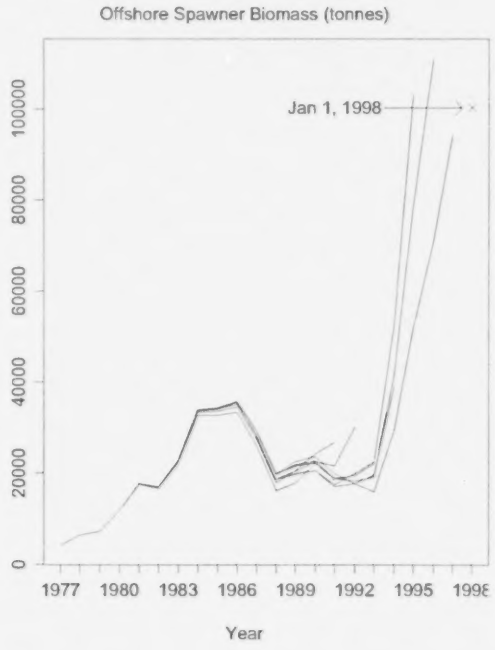
An **acoustic survey** conducted in Placentia Bay in May 1997 located a large dense school of spawning cod off St. Bride's comprising an estimated 40,000 t. Samples taken by handline indicated that fish aged 5,

7 and 8 predominated. An acoustic survey in a portion of Fortune Bay in the winter of 1997 gave an estimate of 2,600 t.

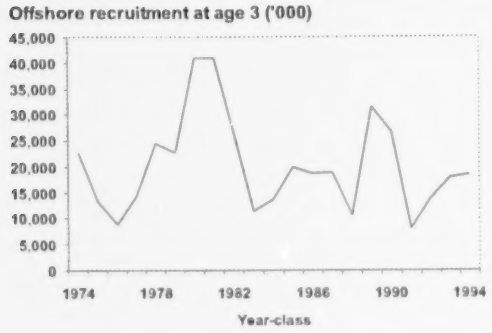
Catch rates from the commercial fishery and sentinel survey do not provide direct measures of stock biomass. An attempt was made to extrapolate the biomass from a mark-recapture study in Placentia Bay during 1997 to the entire inshore area of 3Ps, using gillnet catch rates reported by commercial fishers. The extrapolation gave a biomass estimate of 115,000 for the inshore of 3Ps.

Stock structure and **migration** patterns of 3Ps cod are complex and not fully understood. Estimation of stock size is complicated by a seasonal influx of cod from adjacent management units, notably the northern Gulf of St. Lawrence (3Pn4RS) during winter and possibly the Grand Bank (3L and 3NO) during fall. Migration of offshore components of the stock to inshore areas during spring and summer, as well as the possible existence of inshore components that remain outside the survey areas throughout the year, also complicate the assessment of stock status. **Tagging experiments** were conducted prior to and during the commercial fishing season in Placentia Bay. Tag returns indicated a spring-summer movement of cod from the inner reaches of Placentia Bay toward the mouth of the Bay, particularly along the eastern side and eastward across the stock boundary into 3L, with a return movement back to 3Ps during fall. No cod tagged in Placentia Bay were reported as recaptured from the Gulf of St. Lawrence or from offshore fisheries in 3Ps.

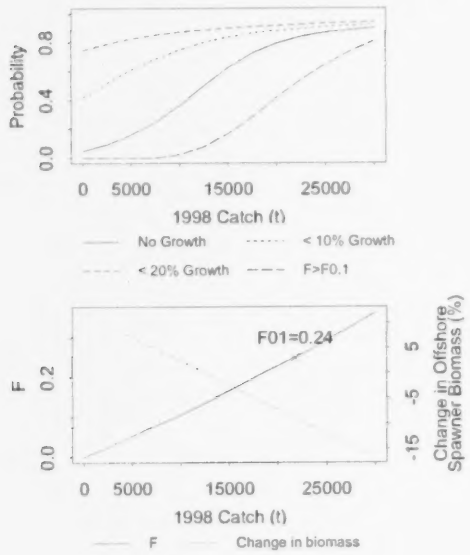
Sequential population analysis based on offshore mobile gear commercial catches and research vessel survey data was used to reconstruct the population. Results indicate that the spawner biomass has increased following the initiation of the moratorium. This is largely a result of the high survival and maturation of the strong 1989 and 1990 year classes combined with a reduction in the age at maturity. The estimate of **offshore spawner biomass** from the analyses was 100,000 t on January 1, 1998. Analyses have shown a retrospective pattern which suggests that future estimates of the 1998 spawner biomass are likely to be revised downwards.



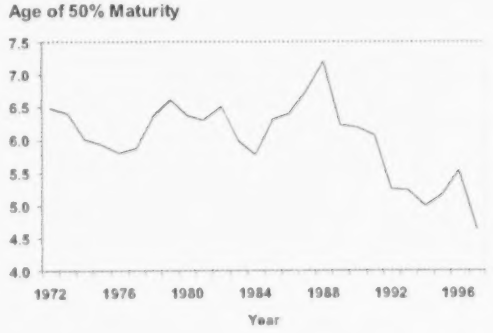
The 1994 year-class in the offshore is poorly estimated in 1997, but there are suggestions that year classes subsequent to 1990 are about 50% of the pre-moratorium historical average, except for 1991 which is the lowest in the entire time series.



A **risk analysis** was carried out to evaluate the probability of exceeding F0.1 for a range of TAC options. This indicated that for a 12,500 t offshore quota in 1998 the probability of fishing mortality exceeding F0.1 is <10%. With such a quota there is a 50% probability that the offshore spawning stock biomass will not increase from 1998 to 1999.

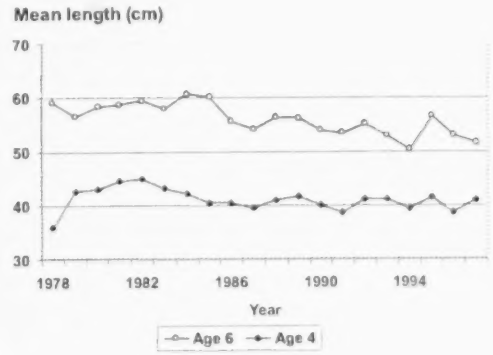


Age at maturity in trawl survey samples has typically averaged 6 years but has been declining in recent years. Age at 50% maturity for females dropped dramatically from a high of 7.2 years during 1988 to a low of 5 during 1994. An apparent reversal of the declining trend during 1995 and 1996 has not been continued. The current (1997) estimate of age at 50% maturity is the lowest in the time series at 4.6 years.



Males generally mature about one year younger than females but show a similar trend over time. Maturities at age in the 1997 sentinel survey are similar to those found in the trawl survey.

Growth, calculated from length-at-age in trawl survey samples, declined among the older ages (age 6) during the past decade but remained constant among younger ages (age 4). Current length-at-age remains low for age 6 cod.



The **age composition** in commercial and sentinel fixed gear catches comprised a range of ages from 3 to 10, but was dominated by 5, 7, and 8 year olds. Otter trawl catches in both the commercial fishery and industry survey also consisted mainly of 5, 7, and 8 year olds. Fish aged 6 were poorly represented in both fixed and mobile gears. Fixed gear catches were widespread within the inshore area, but in the early part of the fishery appeared to target aggregations of fish that were in spawning condition. Otter trawl fishing by trawlers chartered by St. Pierre and Miquelon was concentrated on a small area on St. Pierre Bank.

Ecological factors

Time series of **temperature anomalies** at depths less than 75m show cold periods in the mid 1970s and since the mid 1980s, similar to conditions on the shelf along the east coast of Newfoundland. The most recent cold period, which started around 1984, continued in the early 1990s with temperatures up to 1°C below average, and up to 2°C below the warmer temperatures of the late 1970s and early 1980s in the surface layers. Temperatures in deeper water off the banks show no significant changes. Since 1991, temperatures have moderated somewhat in some areas and deep-water bottom temperatures are above normal, but large areas continued to have anomalously cold temperatures up to 1996, particularly on the eastern portion of St. Pierre Bank. Results from the spring 1997 survey suggest that conditions are variable across the stock area with deep-water bottom temperatures above normal and a continuing cold trend on St. Pierre Bank.

Major Sources of Uncertainty

The origins of fish that make up the 3Ps cod fishery are diverse and as yet not fully understood. This complicates the interpretation of trawl survey, sentinel survey and commercial catch data and reduces confidence in the results of sequential population analysis.

The legitimacy of separate analyses of inshore and offshore data is unknown as are the possible impacts on the stock size evaluations.

The timing of the trawl survey has varied considerably over the years. This introduces uncertainty in the interpretation of abundance estimates because of seasonal migration patterns.

Introduction of the new trawl survey gear during 1996 may result in more reliable estimates of year-class strength at younger ages. However, the uncertainties inherent in the low catches of small fish in the old gear cannot be removed.

The analytic assessment using offshore data demonstrated a significant retrospective pattern which could result in future estimates of the 1998 spawning stock biomass being reduced substantially.

The two most recent estimates of mortality calculated from surveys are thought to be spuriously high because of a single large catch during the 1995 survey and the fact that the 1997 survey did not encounter aggregations subsequently observed by the commercial fishery and the fall industry survey.

The estimate from the fall industry survey is preliminary and needs to be revised based on estimates of swept area and survey area.

Also, this is only the first survey of this new series so any estimate is difficult to interpret.

Extrapolation of the mark-recapture estimate to the entire inshore was based on total area and depends upon the distribution of fish within each area. Such an estimate could be radically different if the proportion of the area inhabited by fish was highly variable.

Several analyses were attempted using historical data from log-books for vessels >35ft and purchase slips. However, these analyses were rejected because the data were not considered to be reliable. New log books introduced during 1997 for vessels <35ft and dockside monitoring show promise in improving the reliability of these data sources in the future.

Outlook

The spawning stock has increased in recent years due to growth and maturation of the relatively strong 1989 and 1990 year classes as well as their survival due to the moratorium. Non-fishing mortality does not appear to have increased in the 3Ps area, unlike the situation for surrounding cod stocks.

There are indications that recent recruitment has been poor.

The estimates for the inshore and offshore sum to a total spawner biomass of about 215,000 t. The associated catch at an F0.1 reference level (0.24) would be about 40,000 t. As noted above, however, there are a number of uncertainties associated with the estimate of spawner biomass; most notable of these are a) whether adjustments for the timing of the survey continue to be valid, b) the retrospective pattern in the analytical assessment using offshore data, and c) the assumptions involved in analysis of the mark-recapture data as well as the extrapolation using the resulting estimate.

There is concern regarding the continued low estimates obtained from the offshore research surveys during the 1990s, and the continuing low age of maturity as this is often an indicator of low stock size.

Because of the uncertainties and concerns, there is a need for caution in management of this resource during 1998. It is considered that exploitation not exceeding about 50% of the reference F0.1 level would provide an adequate margin of safety. An analysis of the offshore data suggests there is <10% chance that the stock is so low that F0.1 would be exceeded at this exploitation level; however, not all of the uncertainties could be included in this analysis. This would translate into a catch of about 20,000 t.

Because of concerns regarding recent recruitment, the fish should be allowed to spawn prior to any fishing in 1998. Therefore no fishery should occur prior to peak spawning which implies a delay in any opening until after the beginning of July.

Fish condition during and immediately after spawning is poor and a further delay in opening would result in substantially improved yields.

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